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# (12) UK Patent Application (19) GB (11) 2 329 877 (13) A

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(54) Abstract Title

Vehicle subframe attached to a structure by non-frangible and frangible mountings

(57) A vehicle energy absorbing system comprises a subframe 18 attached to a structure 12, 14 across a crumple zone 16 by a pair of frangible 24, 26 and non frangible mountings 20, 22. In the event of predetermined impact force F2 being applied within a predetermined angular range relative to the vehicle centre line, the frangible mountings break and permit controlled movement of the frame. The frangible mountings comprise (Fig. 3) a mounting arm (36) with stress raiser (38), flange (30) and a bush support cup (40). The positions of the frangible and non frangible mountings may be reversed and the subframe may also be arranged towards the rear of the vehicle for supporting suspension or a mid mounted power train.

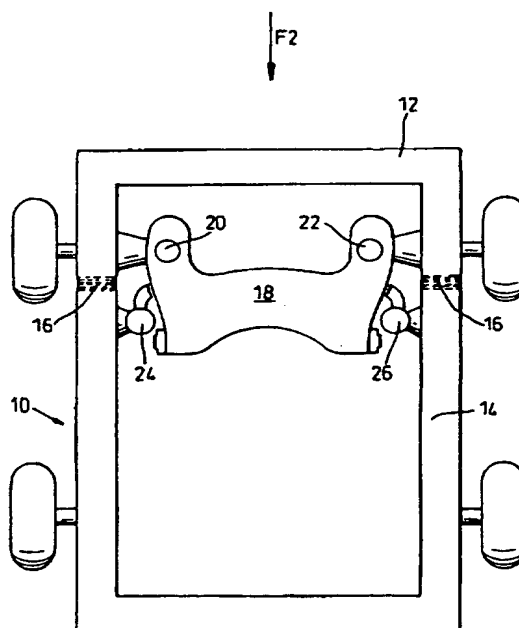
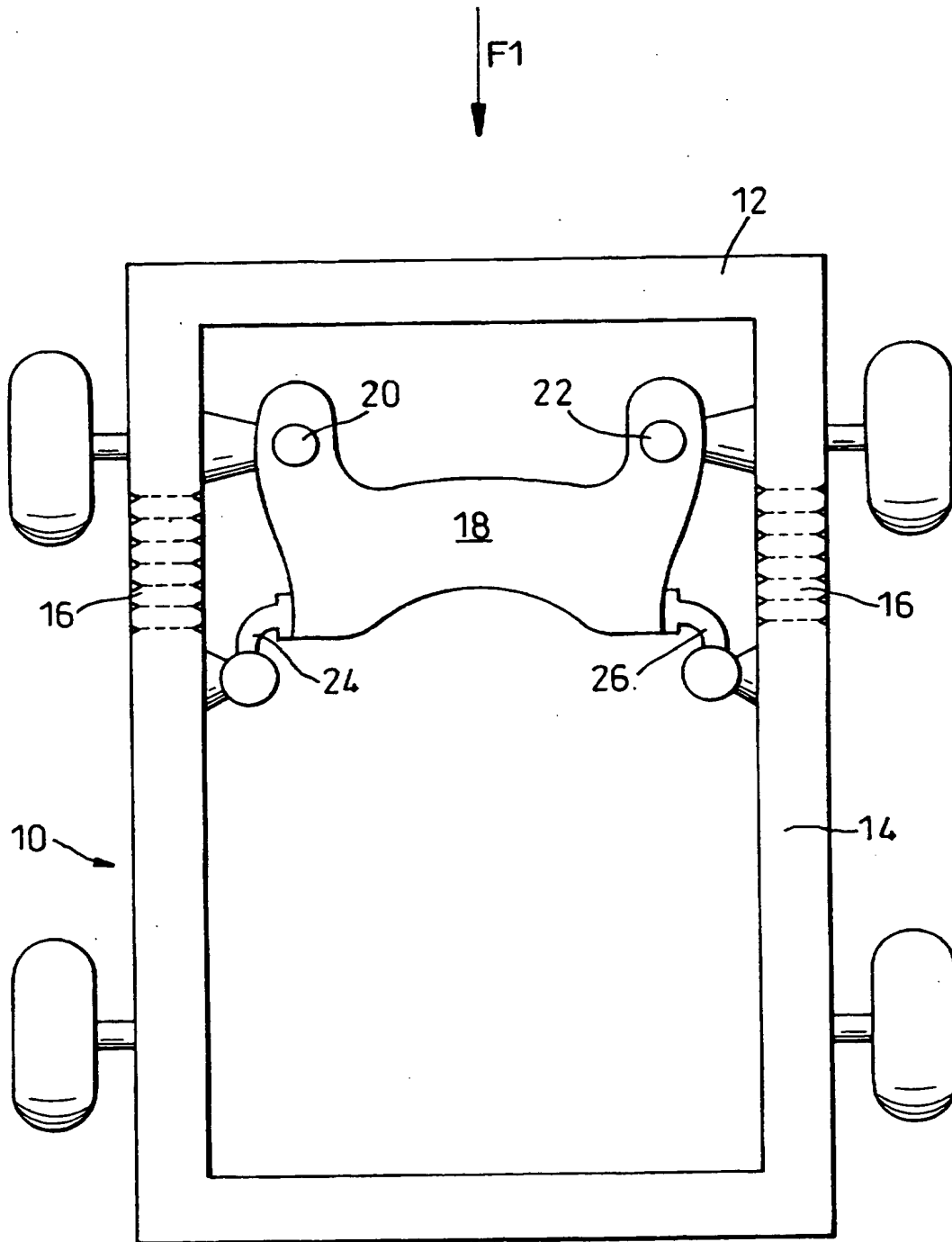


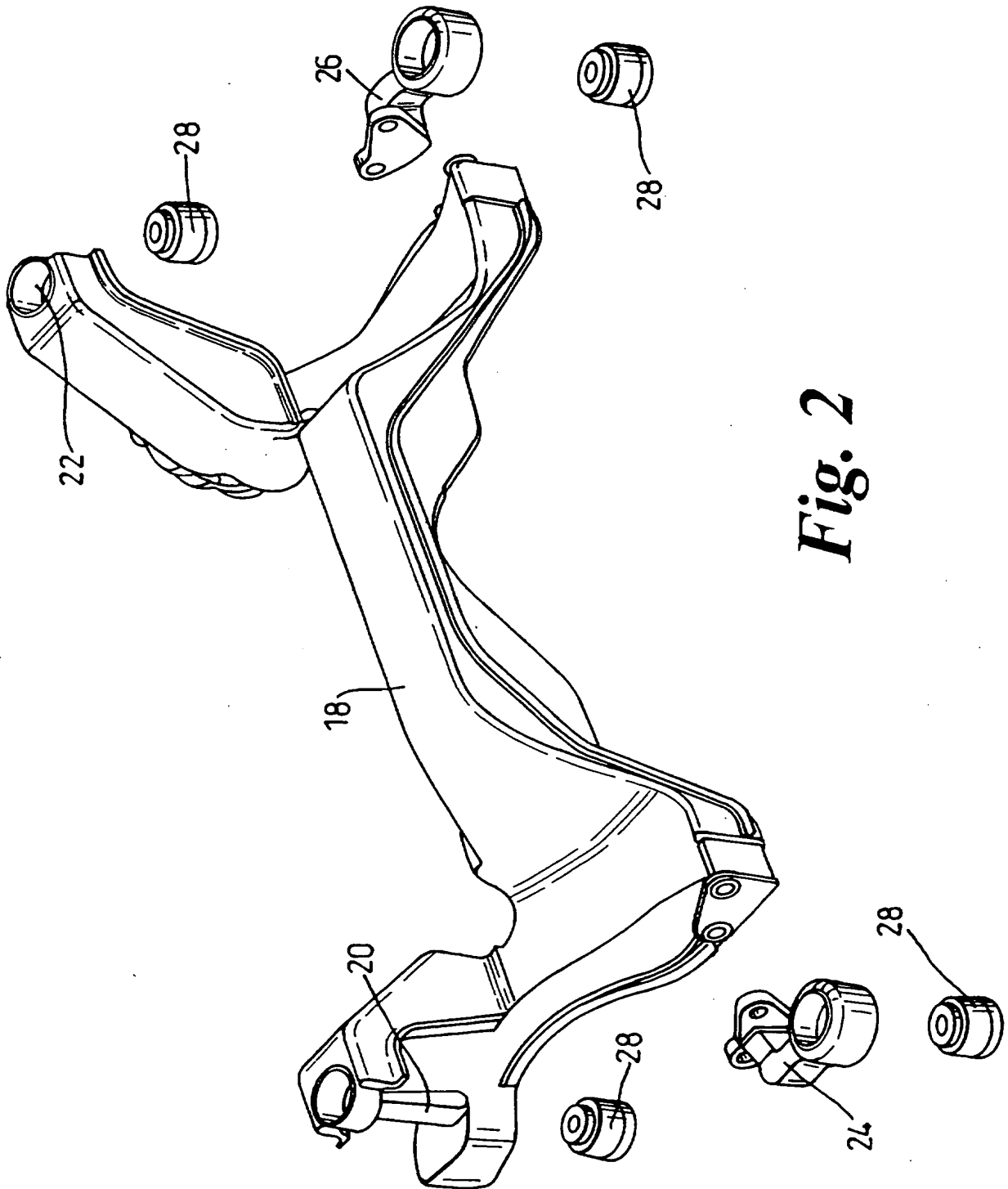
Fig. 4

GB 2 329 877 A

1/4

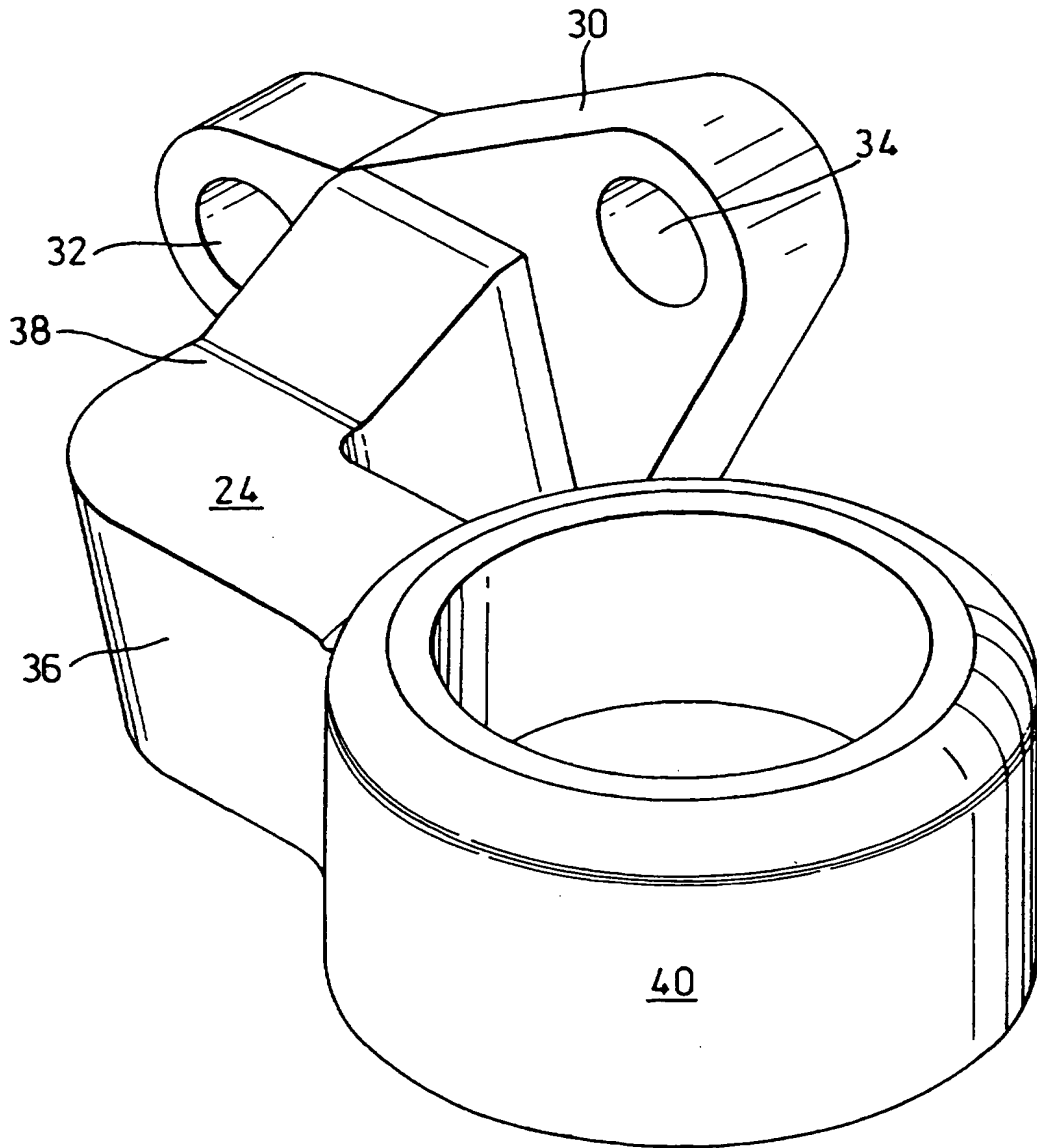


***Fig. 1***



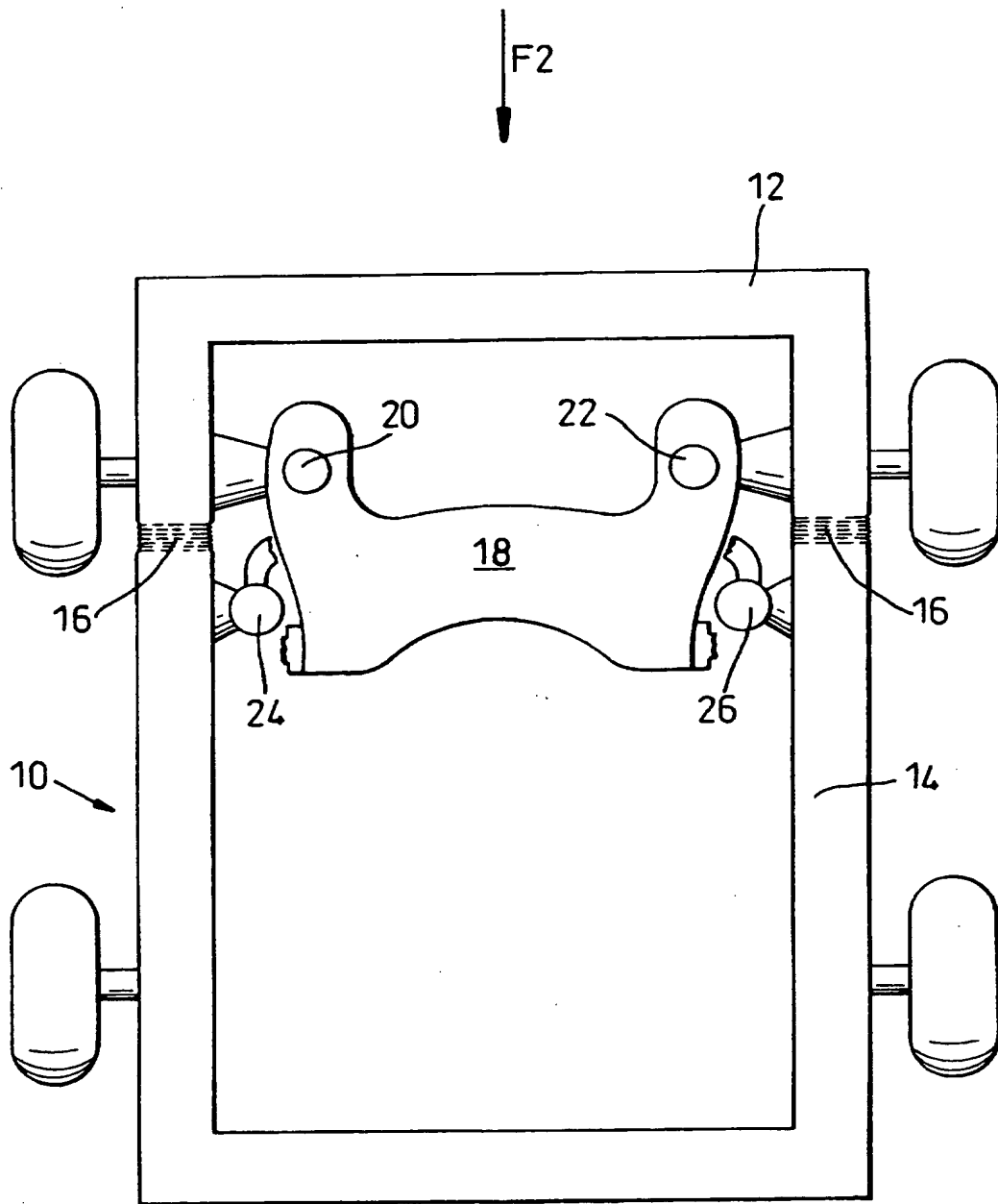
*Fig. 2*

3/4



***Fig. 3***

4/4



***Fig. 4***

A Vehicle

This invention relates to vehicles and in particular to a vehicle having an energy absorbing system.

It is known to provide a vehicle with an energy absorbing system to absorb an impact force which is applied to the vehicle. US 3,869,017 shows  
5 an impact absorbing system for a vehicle which includes a chassis frame having a bumper to absorb minor impacts and a staged crumple zone along the chassis frame itself. The system also includes break-away engine mountings to separate the engine and transmission assembly from the chassis frame in the event of a high energy impact, so that their inertia load  
10 does not interfere with the impact absorbing properties of the crumple zone. It is a disadvantage of a vehicle having this arrangement that, after the engine and transmission assembly have broken-away, their subsequent movement is not sufficiently controlled as they may move around the engine  
15 bay in a substantially unpredictable fashion, being prevented from moving towards the passenger compartment only by the provision of additional metal blocks.

It is an object of this invention to provide a vehicle having an improved energy absorbing system and also to provide a frangible mounting for a sub-frame suitable for use in such a system.

According to the invention there is provided a vehicle having an energy absorbing system comprising a sub-frame attached to a structure by a non-frangible mounting and by a frangible mounting, the frangible mounting being arranged to fracture in use under the effect of a predetermined impact  
5 force directed towards and acting upon the structure, so that the sub-frame breaks away from the structure at the frangible mounting and can move in relation to the structure in the region of the frangible mounting.

The non-frangible mounting may be positioned towards an outer portion of the structure and the frangible mounting may be positioned  
10 inwardly of the non-frangible mounting; alternatively, the non-frangible mounting may be positioned towards an inner portion of the structure and the frangible mounting may be positioned outwardly of the non-frangible mounting.

The frangible mounting may be arranged to fracture under the effect of  
15 the predetermined force only when it is applied within a predetermined angular range of incidence to the vehicle centre line.

The frangible mounting may comprise a casting and may be formed separately from the sub-frame or the structure and may be attachable rigidly to one thereof by a mechanical fixing means.



The frangible mounting may comprise a mounting member which is captured in the frangible mounting and may be arranged to support a fixing means for attaching the frangible mounting to one of the sub-frame or the structure.

- 5       The sub-frame may span at least part of a crumple zone of the vehicle and may be attached to the structure in either the region of the front end of the vehicle or in the region of the rear end of the vehicle.

The invention also provides a frangible mounting for use in a vehicle according to the invention.

- 10       The invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a schematic diagram of a vehicle according to the invention;

Figure 2 is a perspective view of a sub-frame assembly of the vehicle shown in Figure 1;

- 15       Figure 3 is a perspective view of a frangible mounting for use in attaching the sub-frame of Figure 2 to the vehicle of Figure 1; and

Figure 4 is a schematic diagram of the vehicle of Figure 1 after a collision.

Referring to the figures, a vehicle 10 comprises a body structure having a front section 12 and a rear section 14 joined by a crumple zone portion 16.

5        A sub-frame 18 is attached to the front section 12 of the body structure by a pair of non-frangible mountings 20, 22 positioned one each side of the forward facing end of the sub-frame 18. The sub-frame 18 spans the crumple zone portion 16 and is attached to the rear section 14 of the body structure by a pair of frangible mountings 24, 26 positioned one each side of  
10    the rearward facing end of the sub-frame 18.

The non-frangible mountings 20, 22 are formed in the sub-frame 18 itself and each have a pressed-in bush 28 which supports a fixing bolt (not shown) which connects the mountings 20, 22 to the front section 12. The mountings 20, 22 are non-frangible to the extent that they are arranged not  
- 15    to fracture at or below a predetermined impact force F2 when that force is applied towards the vehicle 10 within a predetermined angular range of incidence to the vehicle centre-line.

The frangible mountings 24, 26 comprise castings which are separate from the sub-frame 18 and the body structure 12, 14, 16. The frangible

mountings 24, 26 include a flange 30 which has mounting holes 32, 34 through which fixing bolts (not shown) are passed to attach the frangible mountings 24, 26 to the sub-frame 18. The mountings 24, 26 are frangible to the extent that they are arranged to fracture along a predetermined stress-raiser 38 at or above a predetermined impact force F2 when that force is applied towards the vehicle 10 within a predetermined angular range of incidence to the vehicle centre-line.

A mounting arm 36 extends away from the flange 30 and the stress raiser 38 is formed in it. The arm 36 is set at an angle from the flange 30 so as to direct impact forces which are applied to the sub-frame 18 within the predetermined angular range of incidence to the front section 12 to be transferred to the stress raiser 38.

At its outer end, the arm 36 is formed into a support cup 40 arranged to retain a pressed-in bush 28 identical to the bushes 28 pressed into the non-frangible mountings 20, 22. The bushes 28 in the frangible mountings 24, 26 support fixing bolts (not shown) which connect the mountings 24, 26 to the rear section 14.

In the event of a front end collision, an impact force acts on the front section 12. Up to a predetermined level of impact force, neither the non-frangible mountings 20, 22 nor the frangible mountings 24, 26 will break

and such a low impact force F1 will be transferred from the front section 12 to the rear section 14 through the sub-frame 18 and the crumple zone portion 16. In this manner the vehicle 10 is not severely damaged by low levels of impact force F1 which would not normally distort the crumple zone portion 16, as is best illustrated in Figure 1.

At or above the predetermined level of impact force, a high impact force F2 will be transferred to the stress raiser 38 on the frangible mountings 24, 26 and they will fracture along that section of the arm 36 in a controlled manner causing the sub-frame 18 to break away from the rear section 14 in the region of the frangible mountings 24, 26. At and below this high impact force F2, the non-frangible mountings 20, 22 will not fracture and the sub-frame 18 will remain rigidly attached to the front section 12.

The crumple zone portion 16 then absorbs the high level force F2 and collapses. The fracture of the frangible mountings 24, 26 ensures that the sub-frame 18 moves rearwards in unison with the front section 12 in relation to the rear section 14, as the crumple zone portion 16 collapses.

The rear section 14 is thus substantially isolated from the effects of many front end collisions and is suitable for providing a passenger compartment with improved safety in the event of a collision.

It will be appreciated that the positions of the frangible and non-frangible mountings could be reversed, so that the sub-frame 18 remains attached to the rear section 14 and breaks away from the front section 12.

It will also be appreciated that the invention could equally be applied to  
5 a sub-frame 18 positioned towards the rear end of the vehicle 10, for example supporting a rear suspension system or a mid-mounted powertrain.

It will be appreciated that the specific description of this specification has disclosed only a simple energy absorbing system, in order to maximise the clarity of the description. To apply the invention to a vehicle intended  
10 for production, it may be preferable to include other energy absorbing features which are already known. For example, the crumple zone portion 16 could extend beyond the portion of the body structure spanned by the sub-frame 18 and energy absorbing bumpers could be added to the front section 12.

CLAIMS

1. A vehicle having an energy absorbing system comprising a sub-frame attached to a structure by a non-frangible mounting and by a frangible mounting, the frangible mounting being arranged to fracture in use under the effect of a predetermined impact force directed towards and acting upon the structure, so that the sub-frame breaks away from the structure at the frangible mounting and can move in relation to the structure in the region of the frangible mounting.
2. A vehicle according to Claim 1, wherein the non-frangible mounting is positioned towards an outer portion of the structure and the frangible mounting is positioned inwardly of the non-frangible mounting.
3. A vehicle according to Claim 1, wherein the non-frangible mounting is positioned towards an inner portion of the structure and the frangible mounting is positioned outwardly of the non-frangible mounting.
4. A vehicle according to any one of Claims 1 to 3, wherein the frangible mounting is arranged to fracture under the effect of the predetermined force only when it is applied within a predetermined angular range of incidence to the vehicle centre line.

5. A vehicle according to any preceding claim, the frangible mounting comprising a casting.
6. A vehicle according to any preceding claim, wherein the frangible mounting is formed separately from the sub-frame or the structure and is attachable rigidly to one thereof by a mechanical fixing means.
7. A vehicle according to any preceding claim, the frangible mounting comprising a mounting member which is captured in the frangible mounting and is arranged to support a fixing means for attaching the frangible mounting to one of the sub-frame or the structure.
8. A vehicle according to any preceding claim, wherein the sub-frame spans at least part of a crumple zone of the vehicle.
9. A vehicle according to any preceding claim, wherein the sub-frame is attached to the structure in the region of the front end of the vehicle.
10. A vehicle according to any one of Claims 1 to 8, wherein the sub-frame is attached to the structure in the region of the rear end of the vehicle.
11. A vehicle substantially as described herein with reference to the accompanying drawings.

12. A frangible mounting for use in a vehicle according to any preceding claim.





Application No: GB 9819944.1  
Claims searched: 1-12

Examiner: Phil Thorpe  
Date of search: 14 January 1999

## Patents Act 1977 Search Report under Section 17

### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:  
UK Cl (Ed.Q): B7B BSES, BEXB ;  
Int Cl (Ed.6): B60K 5/00, 5/02, 5/04, 17/00 ; B60R 19/34 ; B62D 21/00 21/15 ;  
Other: Online : WPI, PAJ, EPODOC ;

### Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 1515469 A (Chrysler)	—
X	US 4266630 A (Saab) See figures 1 & 4, column 3 lines 33-40.	1,2,4,6,7, 9,12.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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